Introduction to General Pathology

Lec 1

Pathology: is The study of structural and functional changes in cells, tissues, and organs that underlie disease.

Main aspects:

- Etiology (causes)
- Pathogenesis (mechanisms of disease development)
- Morphologic changes (structural alterations)
- Clinical significance (functional consequences)
- General Pathology focuses on basic mechanisms (e.g., cell injury, inflammation, necrosis) rather than organ-specific diseases.

The Cell as the Basis of Disease

The Cell = basic structural and functional unit of the body.

• Cellular responses to stress or injury:

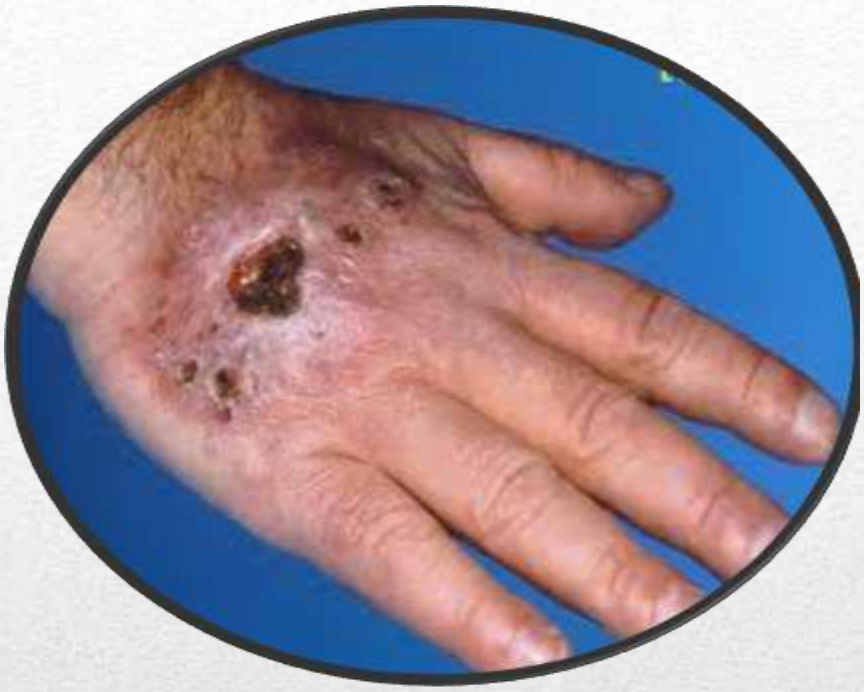
1. Adaptation → reversible if the stress is removed.

2. Reversible injury: temporary changes (e.g., cell swelling, fatty change) that return to normal if the cause is eliminated..

3. Irreversible injury → Cell death:

• Apoptosis (programmed cell death)

• Necrosis (uncontrolled cell death) ← topic of today.



NECROSIS VS APOPTOSIS

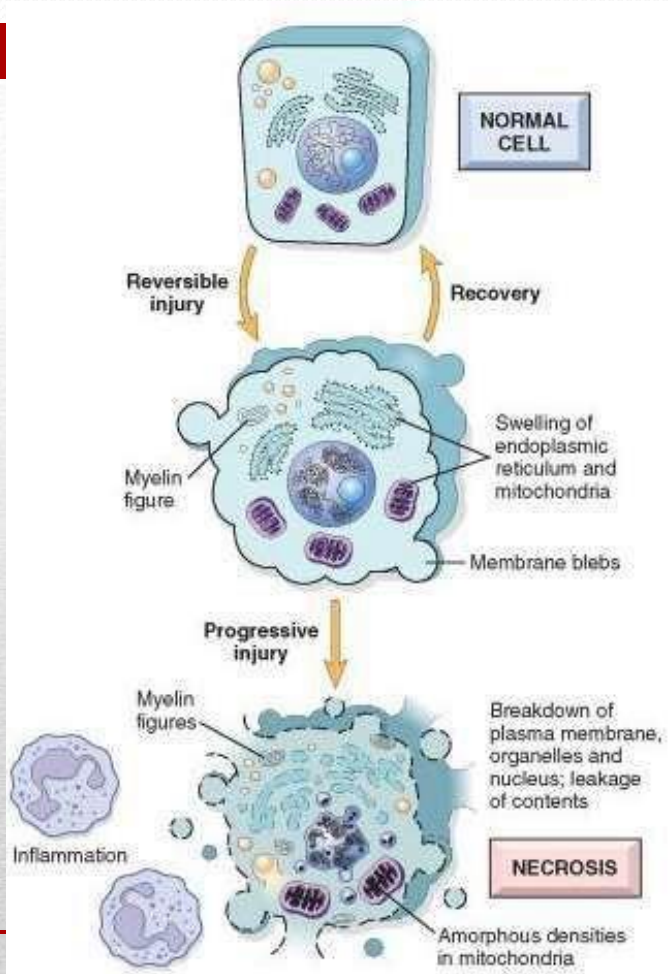
NECROSIS

"Necrosis is the morphological changes that follow cell death in a living tissue or organ

- Resulting from the progressive degenerative action of enzymes on the lethally injured cell."

- Causes of necrosis:
- Anoxia
- Ischemia
- Physical agents
- Chemical agents
- Biological agents

Morphological changes in necrosis



Changes in necrosis

- ✓ Changes inside the cell
- ✓ Changes in mitochondria
- ✓ Changes in Nucleus
- ✓ Changes in cytoplasm

Changes inside the cell

- Endoplasmic reticulum is disorganized
- There is rupture of membrane
- Ribosomes are shed off
- Disorganization of polysomes & their structures

Changes in mitochondria

- Mitochondria become swallon
- Loss of interamitochondrial granules
- Loss of cristae & change their shape
- Rupture of outer membrane of Mitochondria

Changes in Nucleus

- Nucleus becomes smaller
- Chromatin loses & become clumped

➢ Nucleus shows following changes

- Pyknosis
- Karyorrhexis
- Karyolysis

PYKNOSIS

Nuclear shrinkage and increased basophilia ;the DNA condense into a solid shrunken mass

KARYORRHEXIS

“The pyknotic nucleus may break up into fragments and disappear. This process is called karyorrhexis”

KARYOLYSIS

“ Nucleus may undergo lysis by the enzyme DNAse”

CHANGES IN CYTOPLASM

- Cytoplasm becomes more eosinophilic:

Due to loss of RNA & denaturation of cytoplasmic proteins

- Cytoplasm becomes opaque.

TYPES OF NECROSIS

Basic types

- Coagulative necrosis
- Liquefactive necrosis
- Caseous necrosis

In special sites

- Fat necrosis
- Fibrinoid necrosis
- Gangrenous necrosis

COAGULATIVE NECROSIS

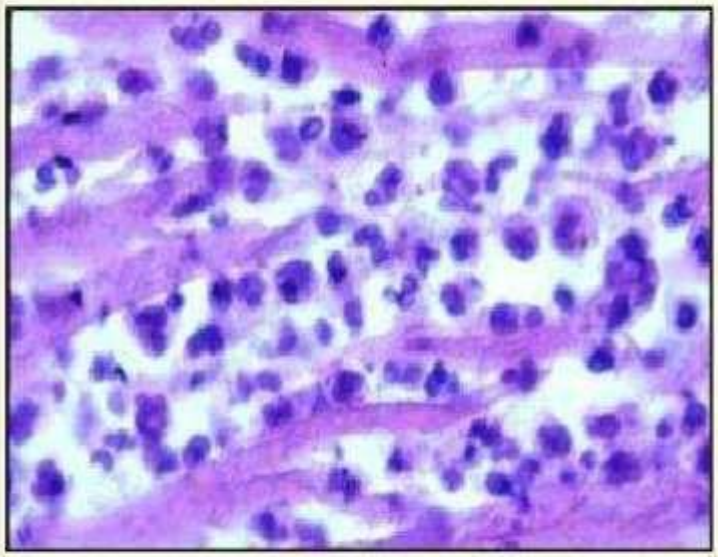
"In this type of necrosis, the necrotic cell retains its cellular outline for several days"

- Coagulative necrosis typically occurs in solid organs except brain such as kidney, heart and adrenal gland usually as a result of deficient blood supply and anoxia.

Examples

- Myocardial infarction

Coagulative Necrosis – Acute Myocardial Infarction



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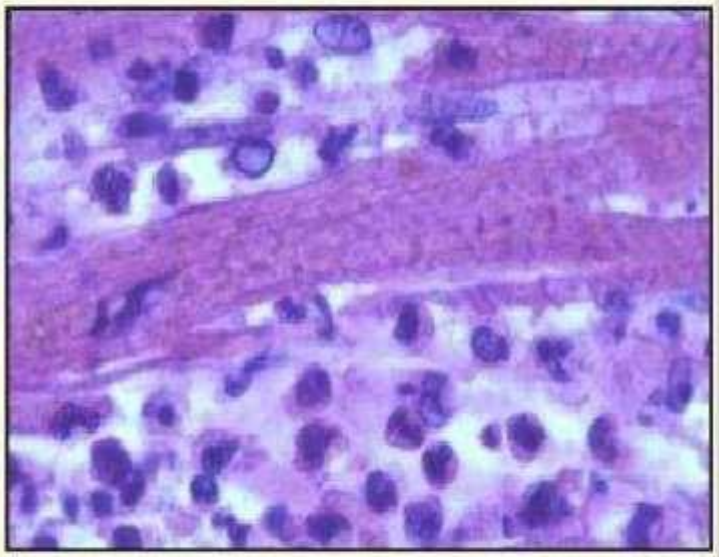

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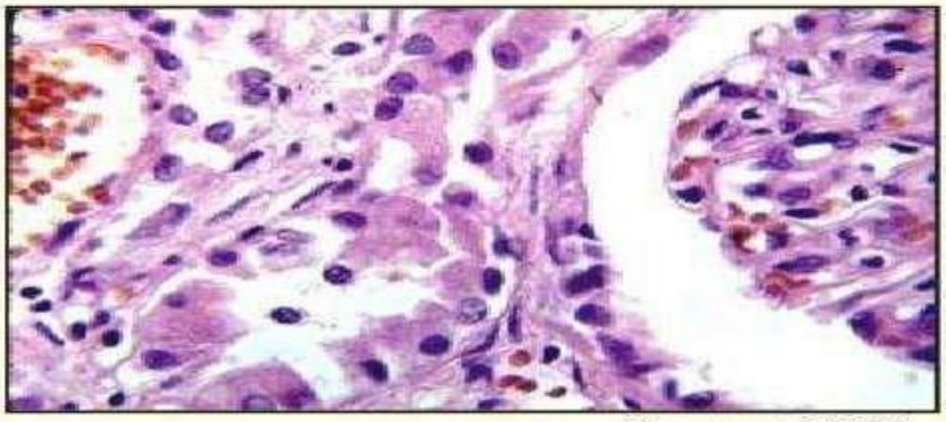
Coagulative Necrosis - Kidney



Normal

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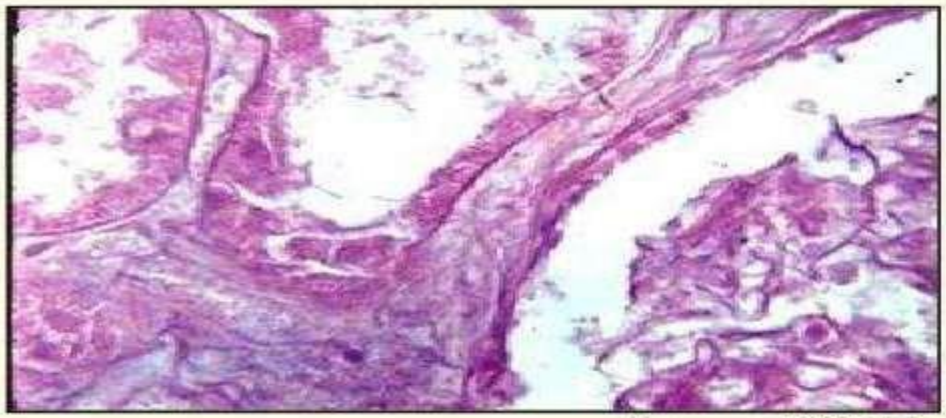

Necrosis

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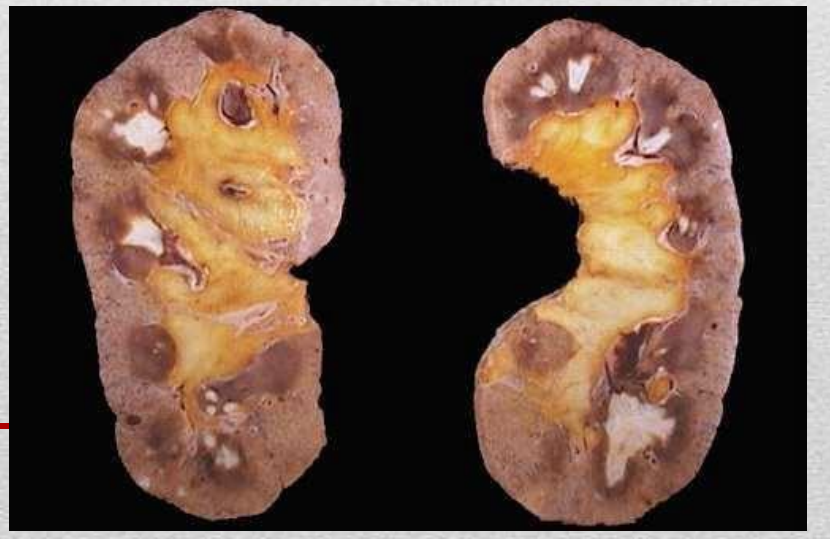


LIQUEFACTIVE NECROSIS

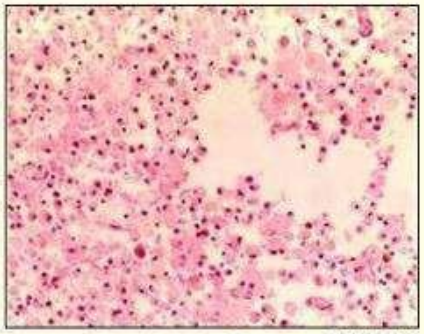
It is the type of necrosis that occurs due to autolytic and heterolytic actions of enzymes that convert the proteins of cells into liquid.

- It is characterized by softening and liquifaction of tissue.

Examples

- Ischemic necrosis of brain
- Suppurative inflammation.

Liquifactive Necrosis - Brain



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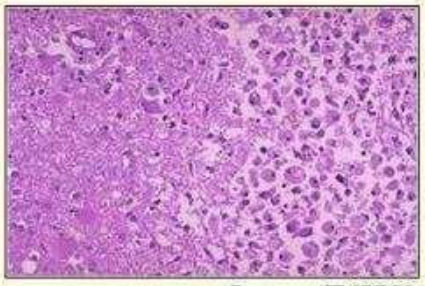

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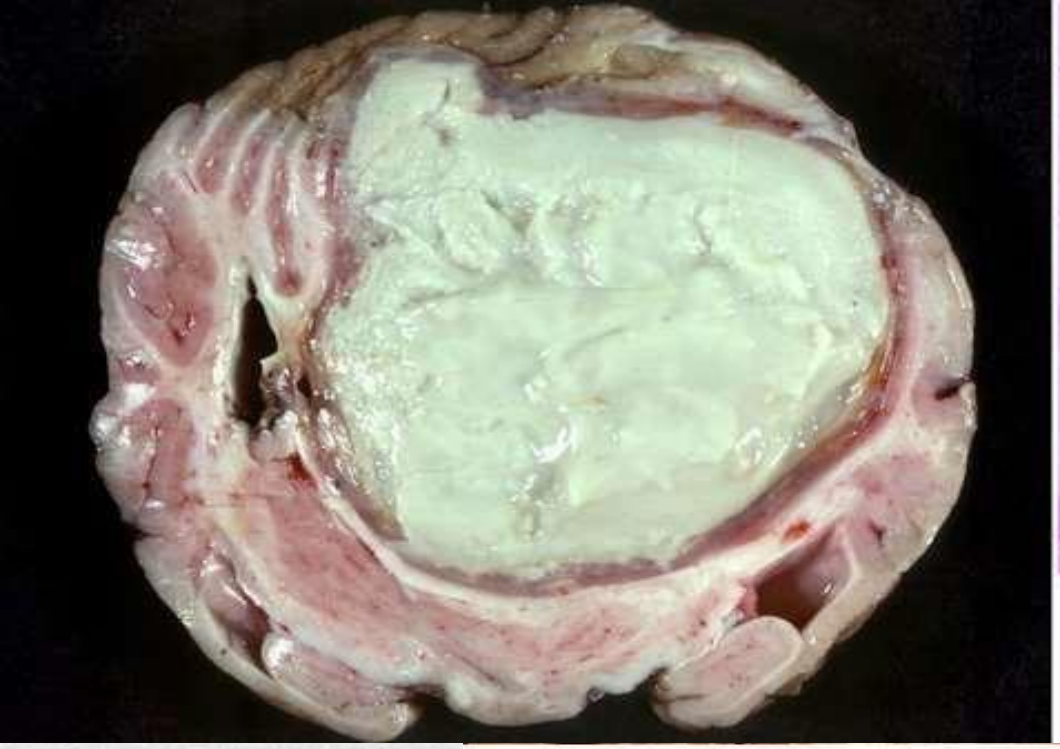
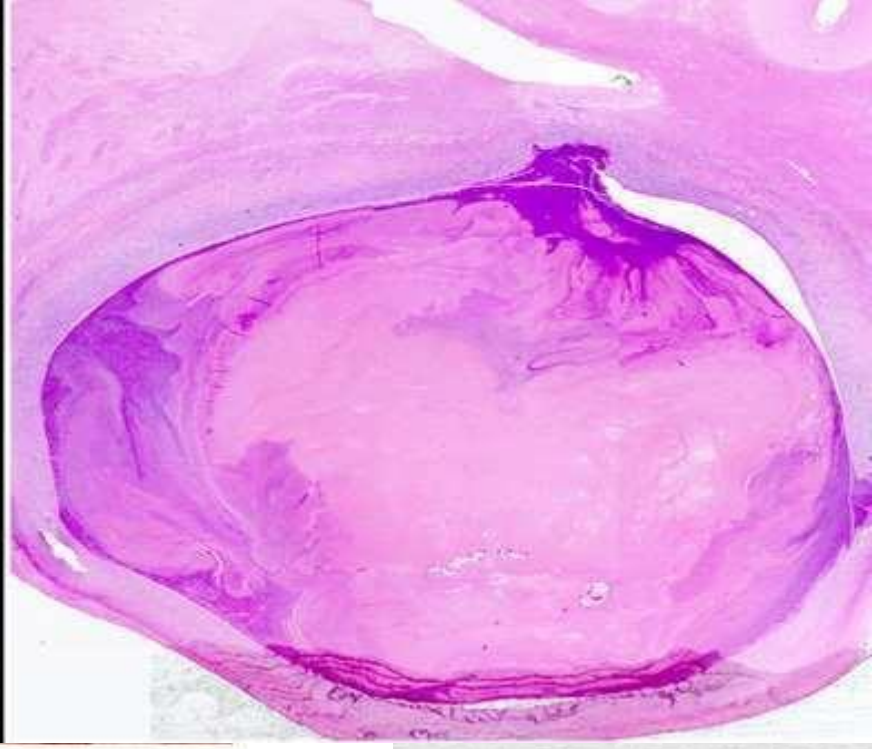




Liquefactive necrosis in brain tissue

CASEOUS NECROSIS

- Characterized by the presence of soft, dry, cheesy homogenous necrotic material.
- It is not liquified

Examples

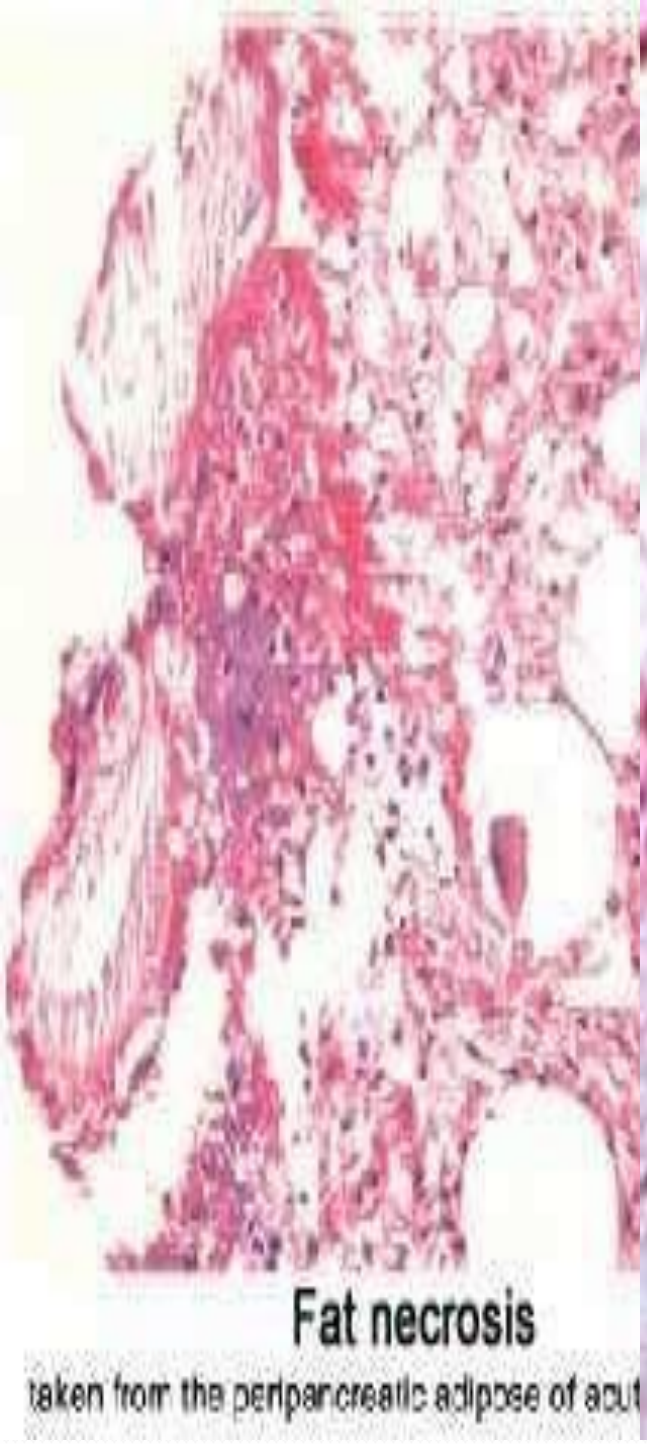
- Principaly in the center of tuberculous granuloma


Caseous necrosis
of granuloma
Lymphocytic
infiltrate

Necrosis in special sites

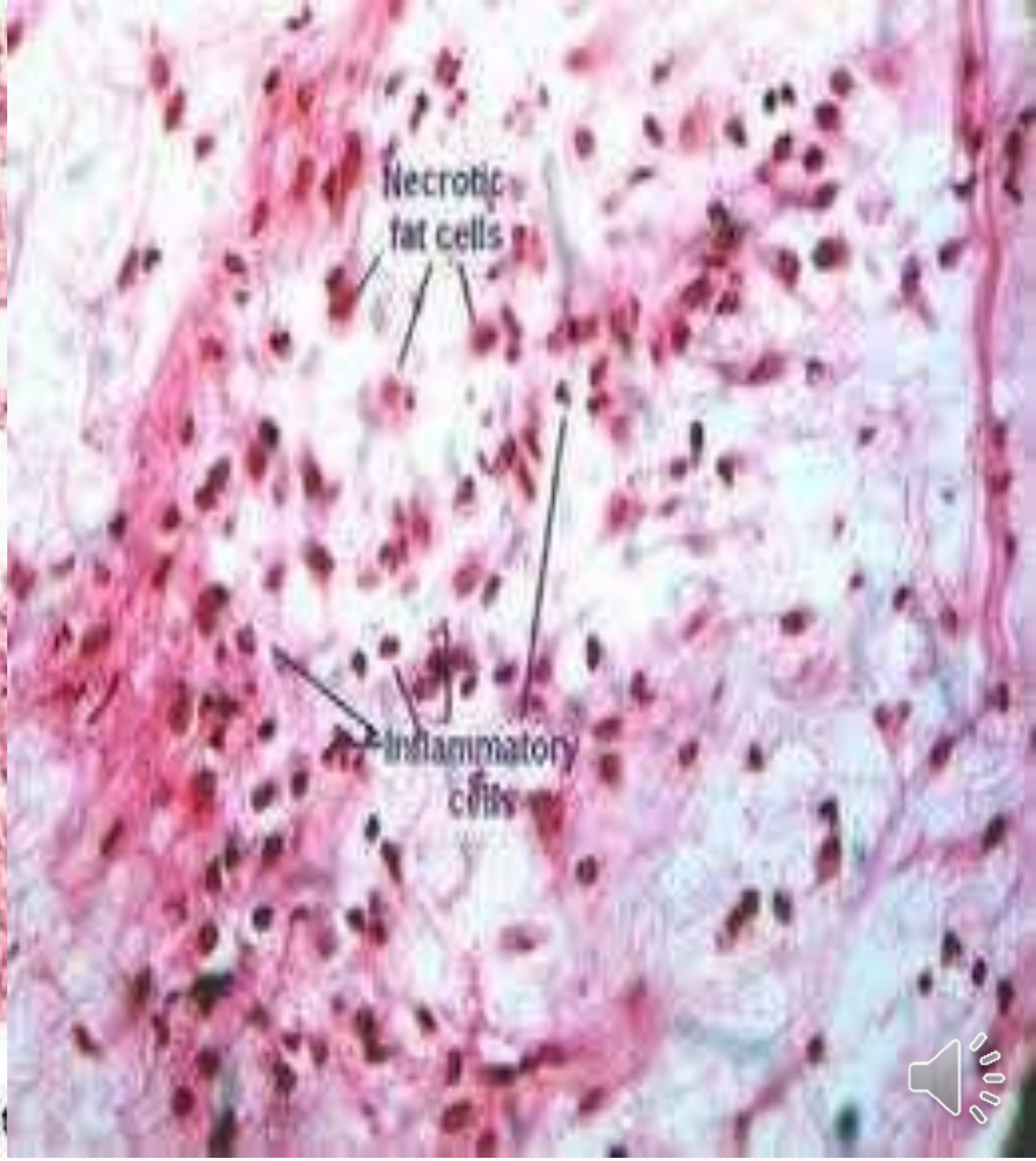
It occurs in two forms:

- Enzymatic fat necrosis
- Traumatic fat necrosis



Fat necrosis

taken from the peripancreatic adipose of acut



FIBRINOID NECROSIS

- Type of connective tissue necrosis especially affecting arterial walls.

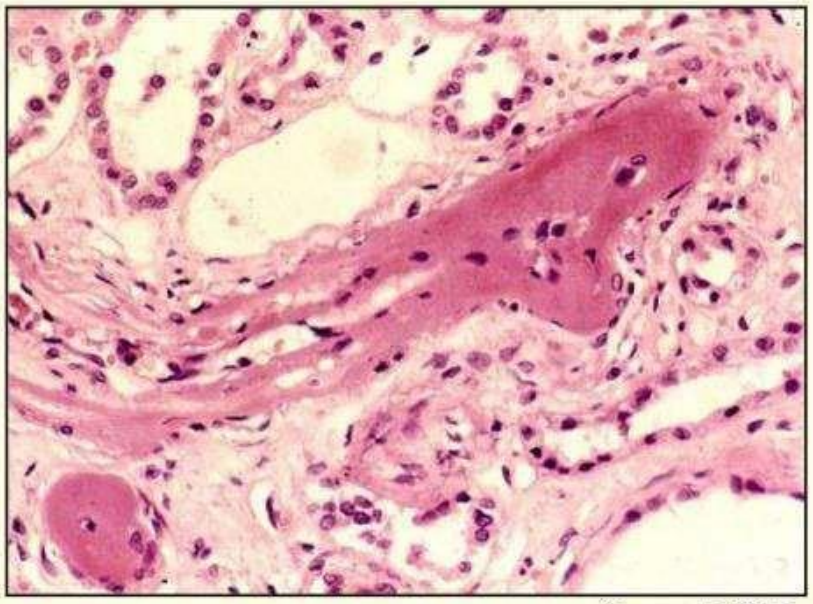
➢ Mostly seen in two conditions

- Auto immune diseases e.g

  Rheumaic fever

- Malignant hypertension

Fibrinoid Necrosis - Artery



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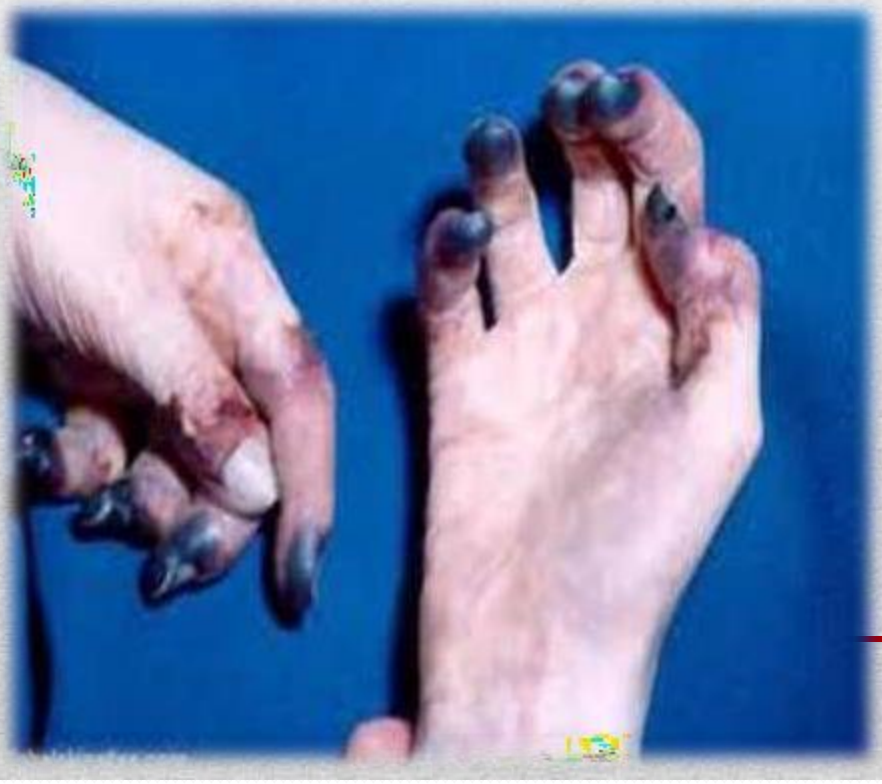
GANGRENOUS NECROSIS

- Gangrene is the necrosis of tissue with superadded putrefaction (enzymatic decomposition).

- Gangree= Necrosis + infection + putrefaction

Clean wound

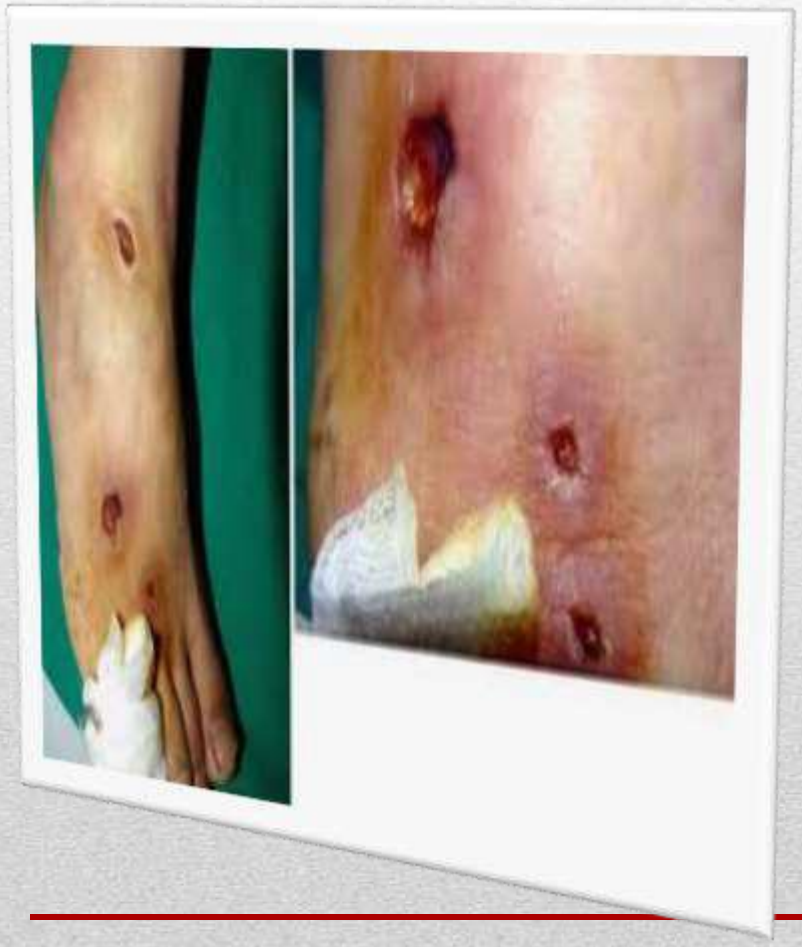
Gangrenous wound

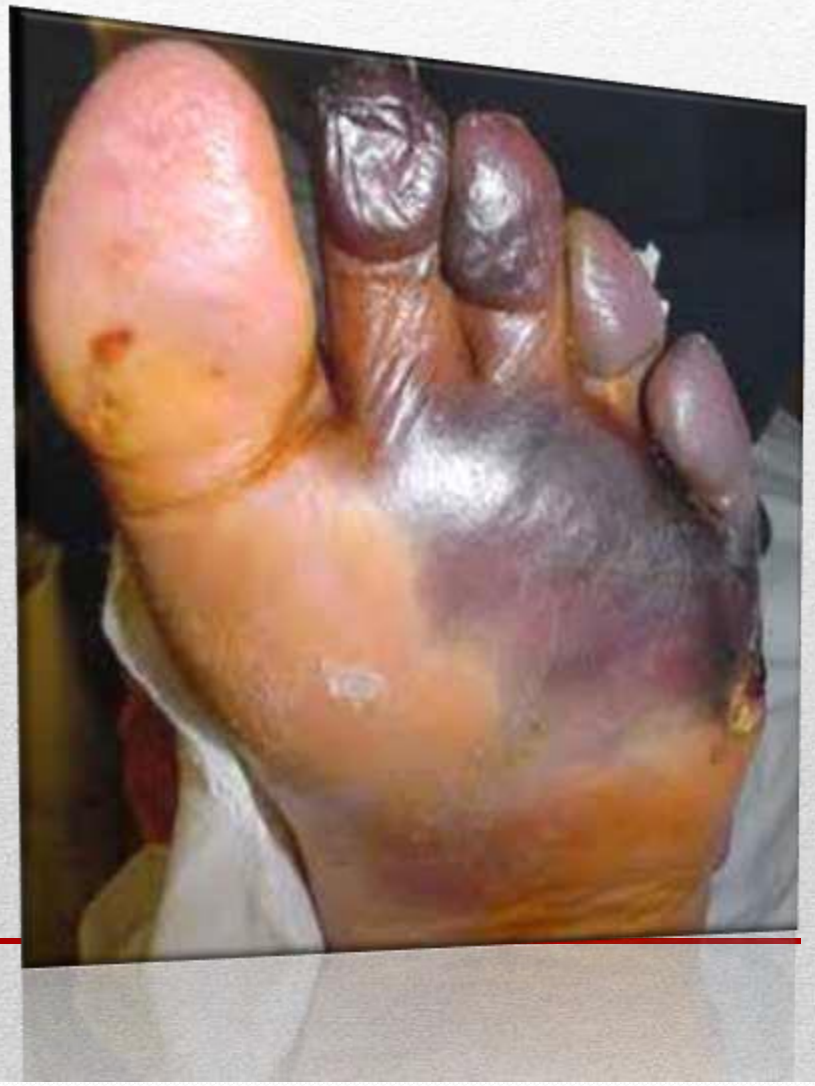


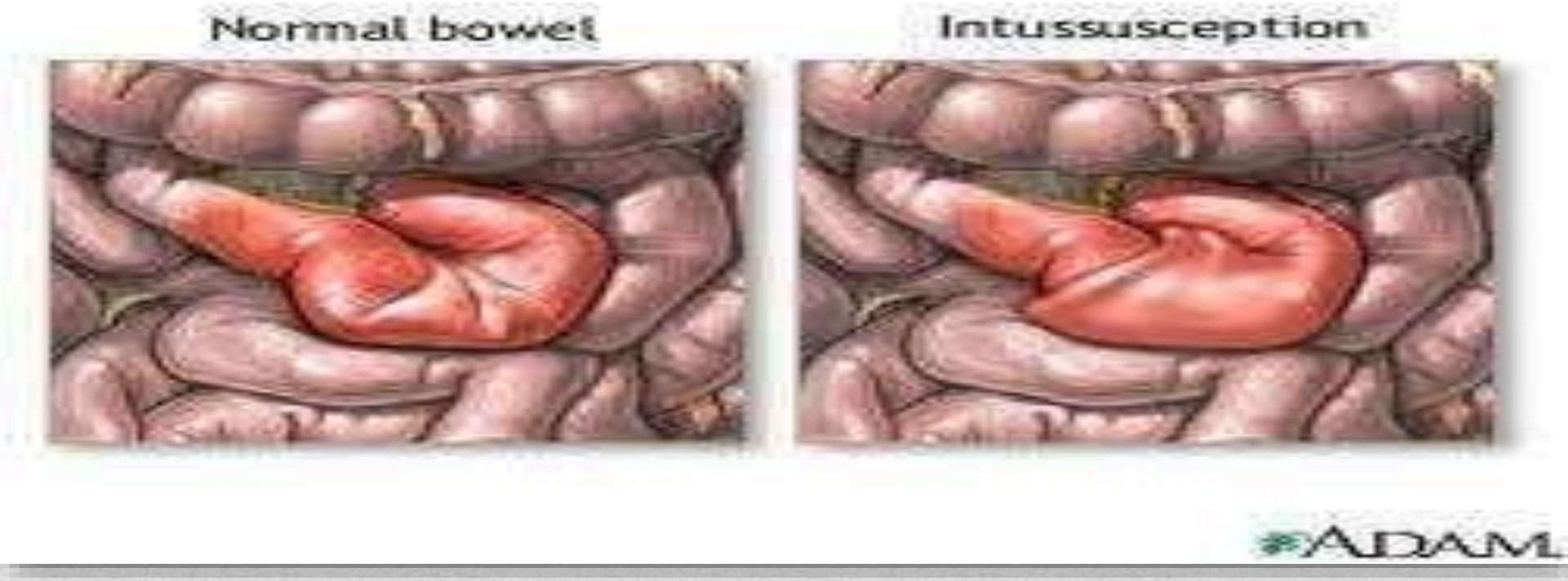
Types of gangrene

- Dry gangrene
- Wet gangrene
- Gas gangrene

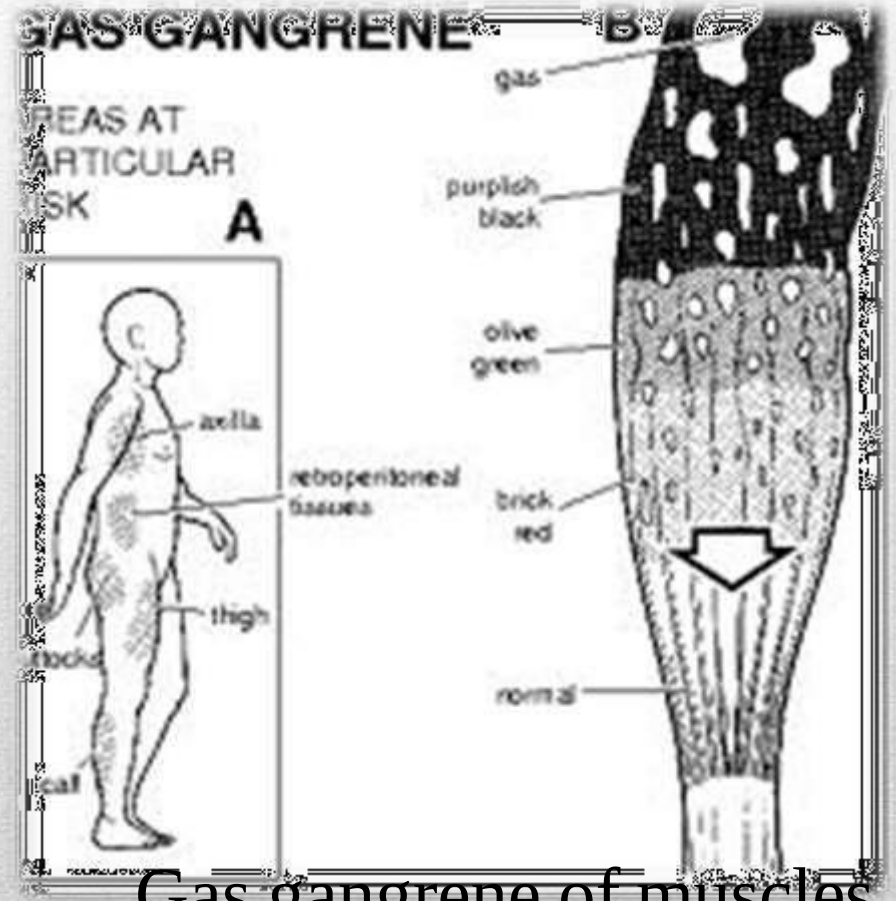
Dry gangrene of foot



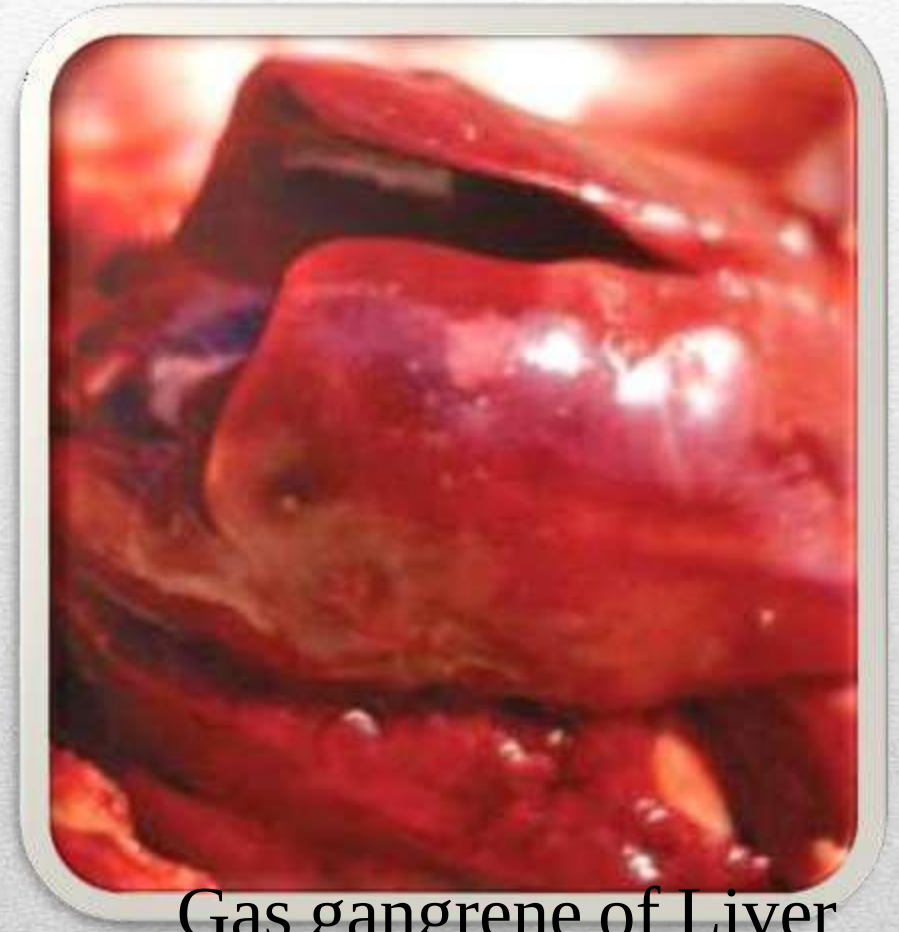




Wet gangrene of appendix



Gas gangrene of muscles



Gas gangrene of Liver

Apoptosis vs Necrosis

Apoptosis vs Necrosis

The word apoptosis mean falling off.

“Apoptosis is a process of programmed and targeted cause of cellular death”

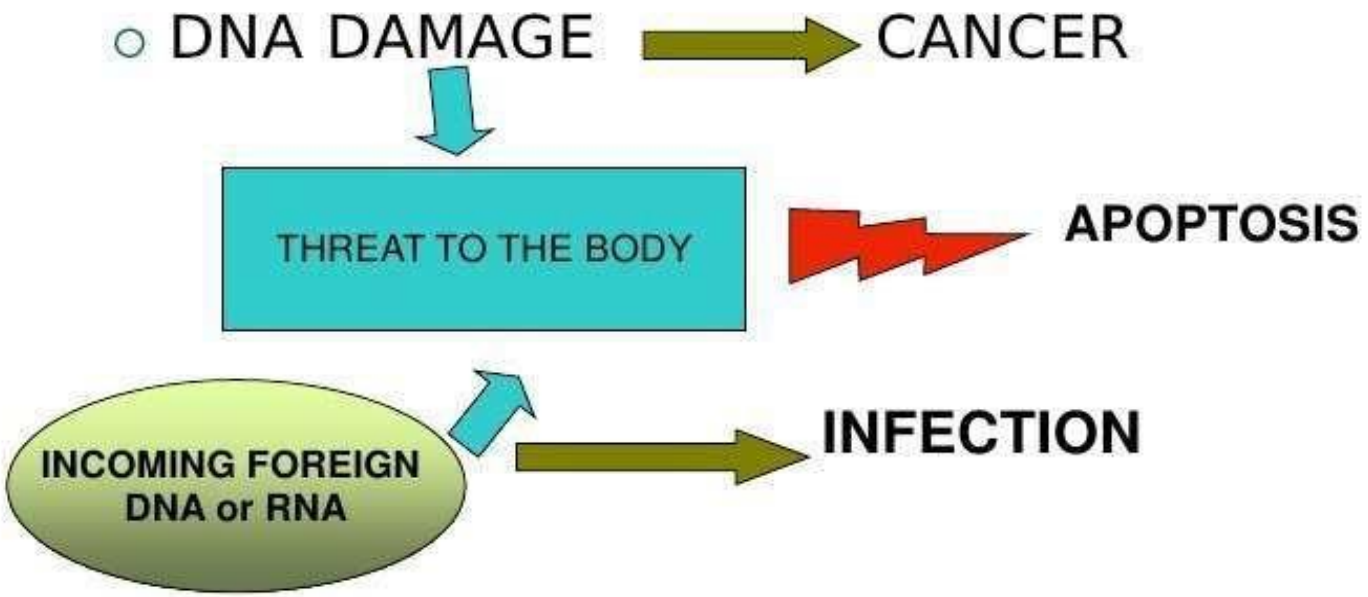
Apoptosis is differ from Necrosis:

APOPTOSIS IS USED TO GET RID OF CELLS THAT ARE POTENTIALLY HARMFUL

PHYSIOLOGICAL CELL DEATH

- The body needs to get rid of cells that are potentially harmful
  - eg mutant cells that could become cancerous self destruct by apoptosis
    - (works via p53; “the guardian of the genome”)
- Auto-reactive lymphocytes die by apoptosis

APOPTOSIS IS OFTEN A DEFENCE AGAINST A THREAT TO THE BODY



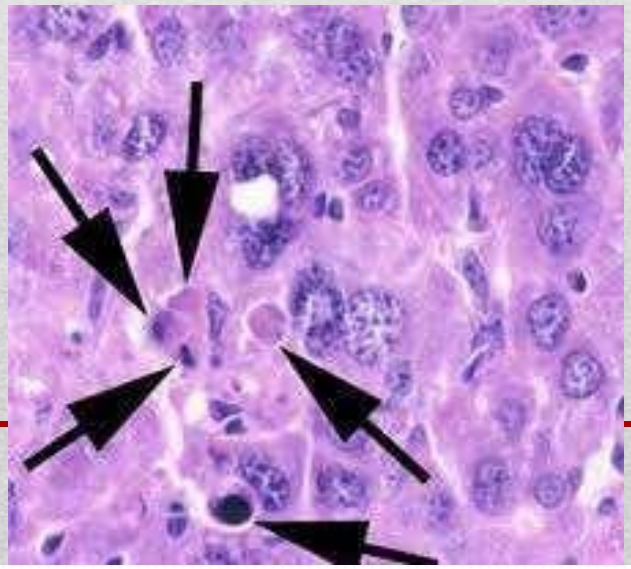
APOPTOSIS INVOLVES AN ORDERLY INTRACELLULAR PATHWAY

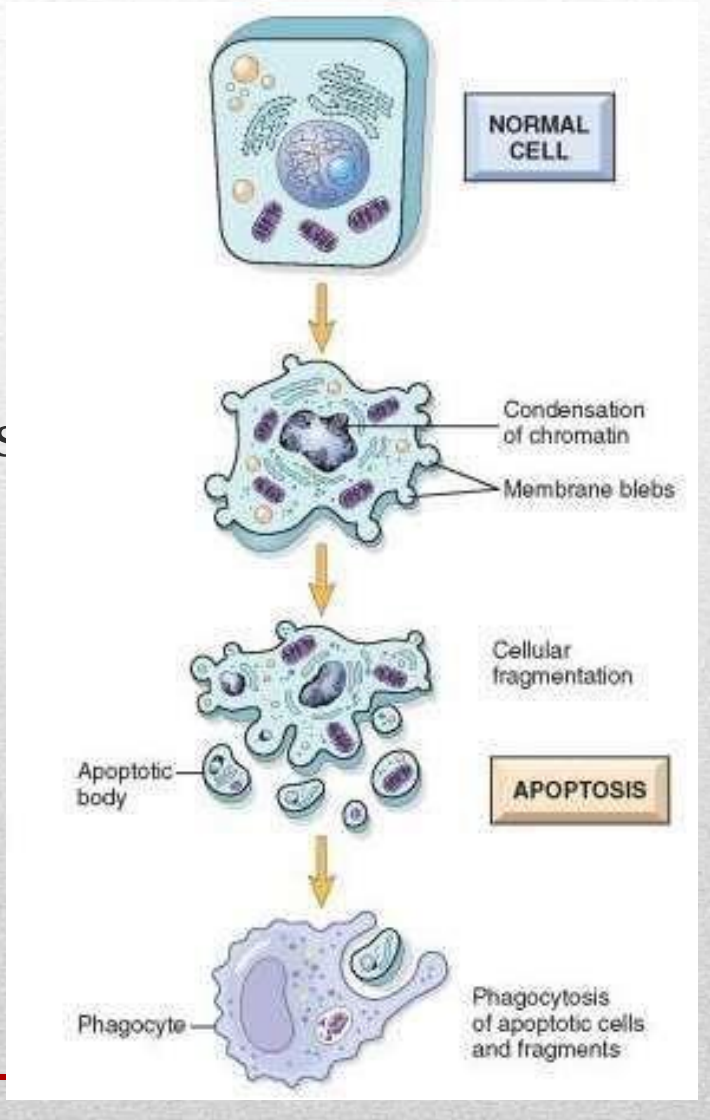
In other words,

apoptosis is not an accident, but rather a complex genetic program for regulation of cell destruction

Morphological changes in apoptosis

- Cell shrinkage
- Nuclear condensation
- Cytoplasmic blebs-Apoptotic bodies
- Phagocytosis





Causes of apoptosis

- Physiological-Programmed cell death
  - Embryogenesis and developmental involution
  - Hormone withdrawal
  - Ovarian atresia-menopause
  - Immature cells-Bone marrow and thymus
  - WBC-End of inflammatory response

Causes of Apoptosis

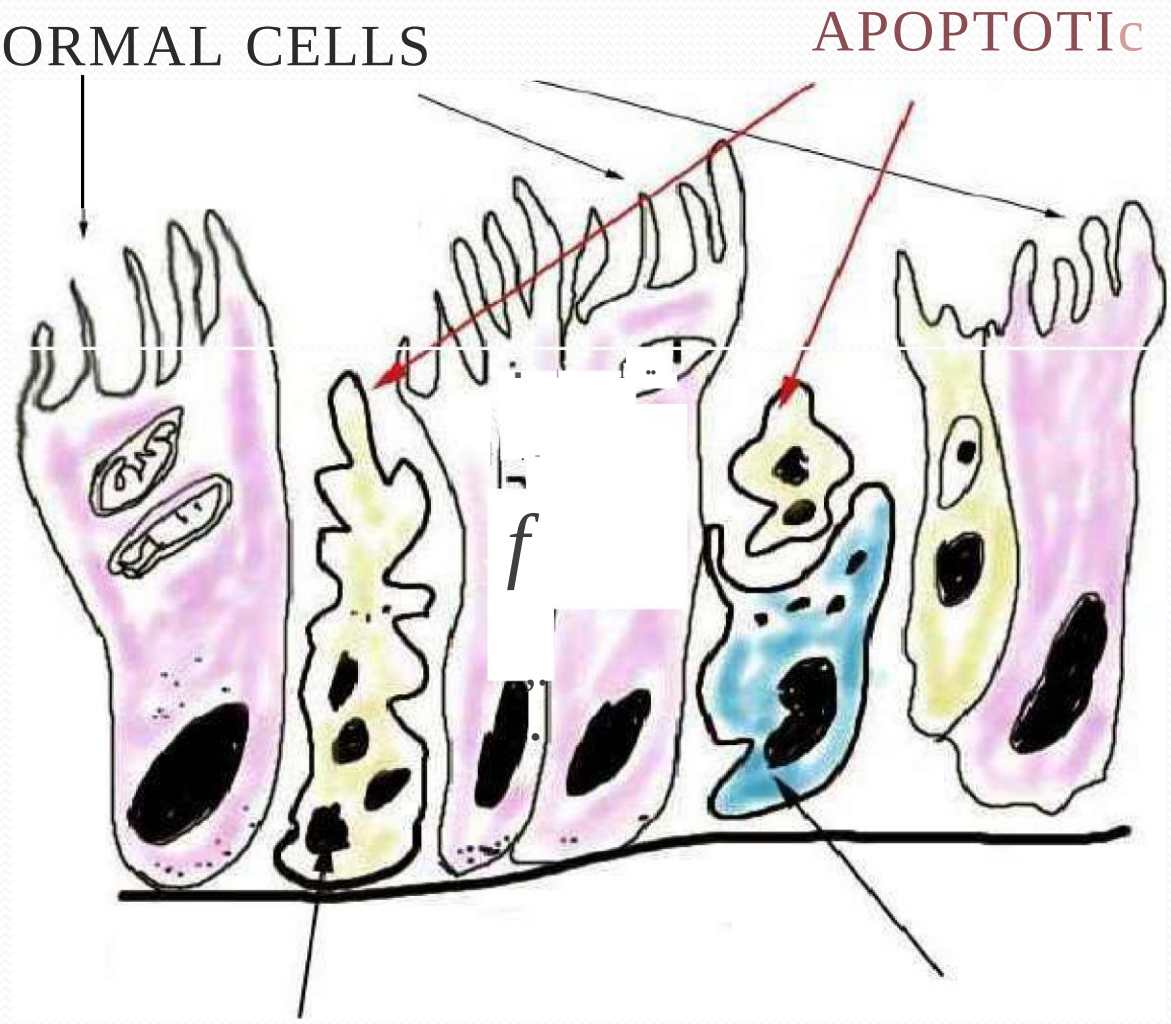
- Pathologic causes of apoptosis

❖ DNA damage-Cytotoxic drugs, radiation and hypoxia

❖ Accumulation of misfolded proteins

❖ Infections: mainly viral by inducing Tcell response

MORPHOLOGY OF APOPTOSIS



Apoptosis	Necrosis
Physiological or pathological	Always pathological
Cell shrinkage	Cell swelling
Apoptotic bodies form	Do not form
DNA cleavage	No DNAcleavage
Beneficial	Detrimental
Characteristic nuclear changes	Nuclei lost
No leak of lysosomal enzyme	Leak of lysosomal enzymes


ThankYou